

In re Application of:
Welker et al.

For: CABLE MOTION DETECTION

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Customer No.: 28116

Commissioner for Patents  
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**APPEAL BRIEF SUBMITTED UNDER 37 C.F.R. § 41.37**

The fee set forth in 37 C.F.R. § 41.20(b)(2) has been paid through credit card. Accordingly, Applicants believe that no fee is due. Nevertheless, the Commissioner is hereby authorized to charge counsel's Deposit Account No. 50-3882/WGEC0079, for any other fees required to make this appeal timely and acceptable to the Office.

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## **I. REAL PARTY IN INTEREST**

The real party in interest of this application is WesternGeco, LLC, as evidenced by the full assignment of the pending application to WesternGeco, LLC recorded at Reel/Frame 014322/0081 in the Assignment Branch of the Patent and Trademark Office.

## **II. RELATED APPEALS AND INTERFERENCES**

Appellants assert that no other appeals, interferences or judicial proceedings are known to the Appellants, the Appellants' legal representative, or Assignee which may be related to, will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

### **III. STATUS OF THE CLAIMS**

Claims 5-6, 18, 25, 30 and 35 are pending in the application and stand rejected. No claims have been allowed. The rejections of claims 5-6, 18, 25, 30 and 35 based on the cited references are being appealed. The pending claims are shown in the attached CLAIMS APPENDIX.

#### **IV. STATUS OF AMENDMENTS**

All amendments have been entered by the Examiner and are reflected in the listing of claims shown in the attached CLAIMS APPENDIX. There are no other amendments that have not been entered.

## V. SUMMARY OF CLAIMED SUBJECT MATTER

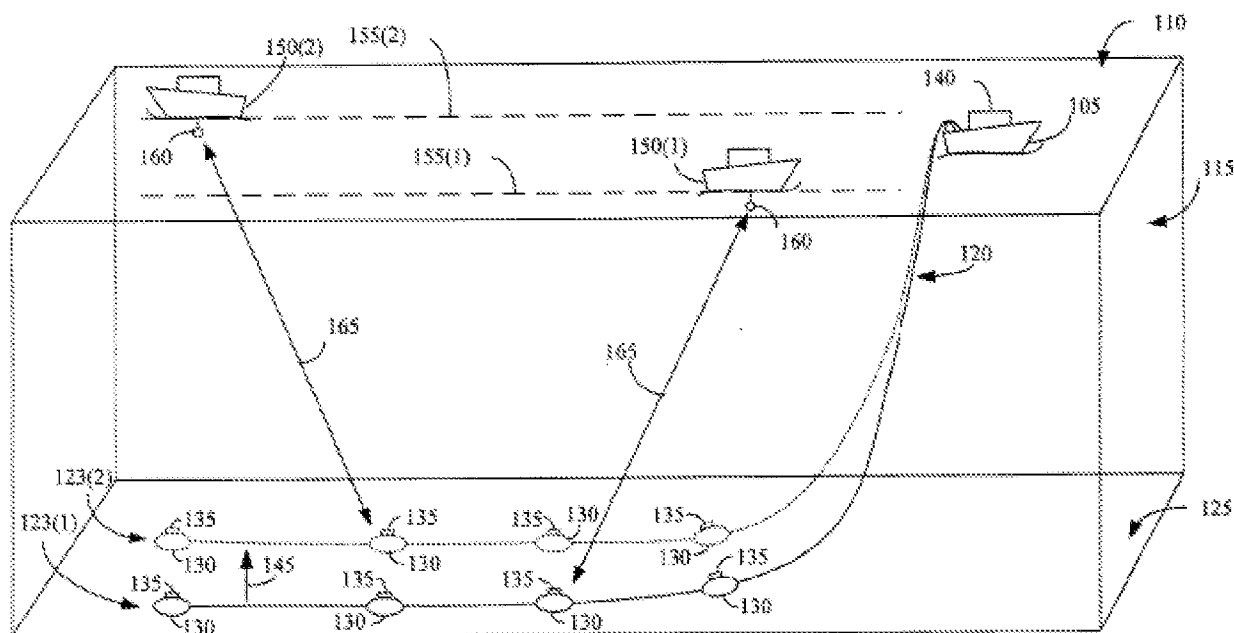
The claimed invention is generally directed to underwater seismic exploration, which is widely used to locate and/or survey subterranean geological formations for hydrocarbon deposits. An ocean bottom cable including an array of seismic sensors may be deployed on the sea floor and one or more seismic sources may be towed along the ocean's surface by a survey vessel. The seismic sources generate acoustic waves that travel to the geological formations, where they are reflected and propagate back to the seismic sensors. The seismic sensors receive the reflected waves, which are then processed to generate seismic data. Analysis of the seismic data may indicate probable locations of geological formations and hydrocarbon deposits. See paragraph [0004].

The deployed cable often moves during the seismic survey. For example, high currents and/or turbulence in the water may shift the position of the cable. If the cable moves more than an acceptable distance from its initial position, it may be necessary to correct the seismic survey data, e.g., during subsequent data processing. See paragraph [0006].

Accordingly, one or more independent claims involved in the appeal are directed to a system for carrying out a seismic survey, which may include at least one ocean bottom cable (Figure 1, ref. 120), at least one seismic sensor (Figure 1, ref. 135) coupled to the at least one ocean bottom cable (Figure 1, ref. 120), at least one orientation sensor (Figure 1, ref. 135) coupled to the at least one ocean bottom cable (Figure 1, ref. 120), and a signal processing unit (Figure 1, ref. 140) capable of: determining at least one initial value of a DC signal of the at least one orientation sensor (Figure 3, ref. 310), determining at least one current value of a DC signal of the at least one orientation sensor (Figure 3, ref. 330), comparing the at least one initial value of the DC signal of the at least one orientation sensor to the at least one current value of the DC signal of the at least one orientation sensor (Figure 3, ref. 340), and determining whether the at least one ocean bottom cable has moved based on the comparison.

One or more independent claims involved in the appeal are also directed to determining whether the ocean bottom cable has moved, which may include determining at least one initial value of a DC signal of at least one orientation sensor

Figure 1 is reproduced below for the convenience of the Board. In one implementation, an ocean bottom cable (Figure 1, ref. 120) may be deployed from a survey vessel (Figure 1, ref. 105). See paragraph [0019]. A plurality of sensors (Figure 1, ref. 130) may be coupled to the cable (Figure 1, ref. 120). See paragraph [0020].



### Figure 1

During or subsequent to deployment, the seismic sensors (Figure 1, ref. 130) may come to rest at a variety of orientations and/or inclinations when deployed on the floor (Figure 1, ref. 125). The orientations and/or inclinations may be measured by inclinometers (Figure 1, ref. 135), which may be configured to measure the orientation



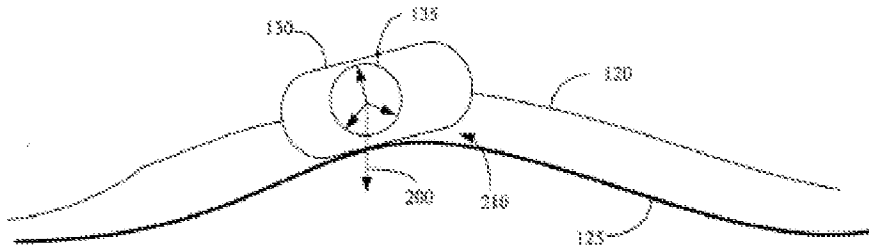
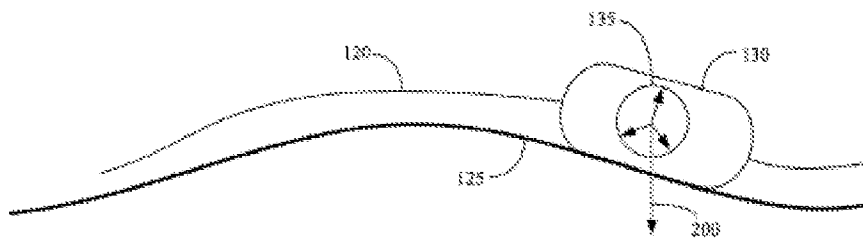
and/or inclination of the associated seismic sensor (Figure 1, ref. 130) with respect to the gravitational field. See paragraph [0023].

The seismic cable (Figure 1, ref. 120) may move from a first cable position (Figure 1, ref. 123(1)) on the floor (Figure 1, ref. 125) to a second cable position (Figure 1, ref. 123(2)). For example, currents in the body of water (Figure 1, ref. 115) may cause the cable (Figure 1, ref. 120) to move along the direction indicated by the arrow (Figure 1, ref. 145). See paragraph [0026].

The seismic sensors (Figure 1, ref. 130) and/or the inclinometers (Figure 1, ref. 135) may electronically communicate with a signal processing unit (Figure 1, ref. 140). See paragraph [0025]. In one implementation, the signal processing unit (Figure 1, ref. 140) may determine at least one initial inclination value of the seismic sensors (Figure 1, ref. 130) before a survey operation. The signal processing unit (Figure 1, ref. 140) may then determine at least one current inclination value of the seismic sensors (Figure 1, ref. 130) during or after a survey operation. By comparing the initial and current inclinations, the signal processing unit (Figure 1, ref. 140) may determine whether the cable (Figure 1, ref. 120) has moved. See paragraph [0029].

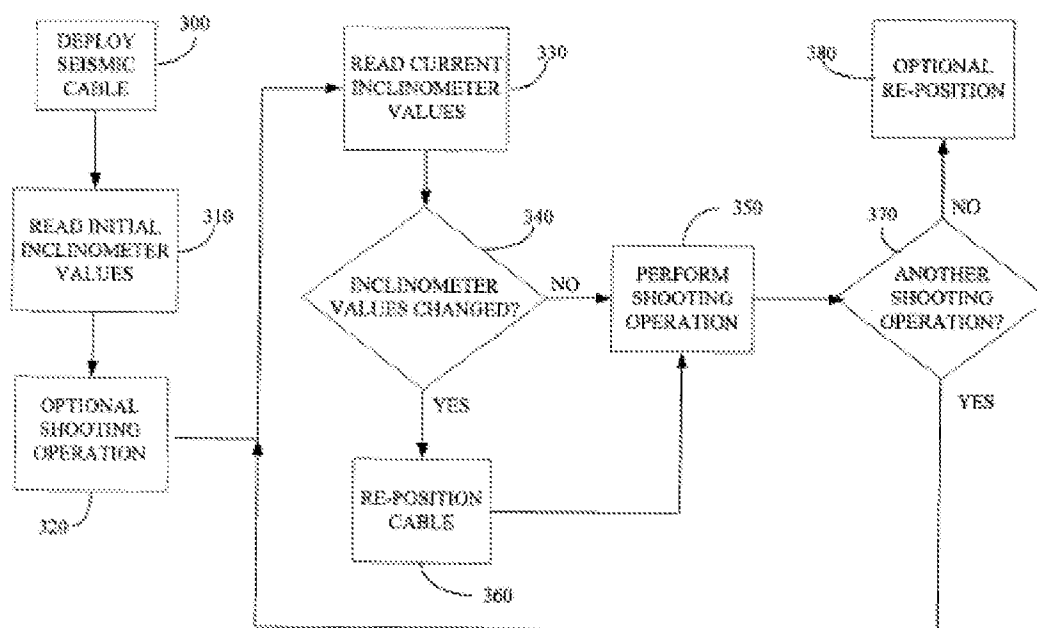
In one implementation, the inclinometer (Figure 2, ref. 135) provides a DC signal when the inclinometer (Figure 2, ref. 135) is at rest and an AC signal in response to a change in the orientation and/or inclination of the inclinometer (Figure 2, ref. 135). For example, when the inclinometer (Figure 2, ref. 135) is at rest, the inclinometer (Figure 2, ref. 135) provides an initial DC signal indicative of the orientation and/or inclination of the inclinometer (Figure 2, ref. 135) relative to the gravitational field (Figure 2, ref. 200).

Figure 2 is reproduced below for the convenience of the Board.

**Figure 2A****Figure 2B**

If the inclinometer (Figure 2, ref. 135) is moved, it may provide an AC signal in response to the motion. Once the moving inclinometer (Figure 2, ref. 135) comes to rest at a new orientation and/or inclination, the inclinometer (Figure 2, ref. 135) may provide a new DC signal indicative of the new orientation and/or inclination. The new DC signal is typically different than the initial DC signal, although in some unlikely instances it may be possible for the new DC signal and the initial DC signal to be the same. See paragraph [0032].

Figure 3 illustrates an implementation of a method for detecting motion of an ocean bottom cable 120 using the inclinometers 135. Figure 3 is reproduced below for the convenience of the Board.

**Figure 3**

At step 300, the cable 120 may be deployed. At step 310, one or more initial inclinometer values may be read. For example, the one or more initial inclinometer values may include one or more DC signals indicative of the orientation and/or inclination, relative to the gravitational field, of one inclinometer 135 in one seismic sensor 130. See paragraph [0033].

At step 320, an optional seismic shooting operation may be performed after the initial inclinometer values are read. See paragraph [0034].

At step 330, current inclinometer values may be read and then compared to the initial inclinometer values to determine whether the inclinometer values have changed (step 340). See paragraph [0035]. If it is determined that the inclinometer values have not changed, indicating that the seismic cable (Figure 1, ref. 120) has not moved, a seismic shooting operation may be performed (at 350). If it is determined (at 340) that the inclinometer values have changed, indicating that the seismic cable 120 has moved, the seismic cable 120 may be repositioned (at 360). After repositioning the seismic cable 120, a seismic shooting operation may be performed (at 350). See paragraph [0036].

By determining whether the seismic cable (Figure 1, ref. 120) has moved using the above-described techniques, time periods between the detected movements of the seismic cable (Figure 1, ref. 120) may be mapped and the acoustic data recorded during these time periods may be grouped together. The grouped acoustic data may then be used to compute improved position estimates for the appropriate time periods. Furthermore, when operated in a continuous mode, movements of the seismic cable (Figure 1, ref. 120) may be detected in real-time, allowing extra position determination operations to be performed when necessary. Consequently, the positions of the seismic sensors (Figure 1, ref. 130) may be determined more accurately, which may result in improved quality of the representations of geological formations, including valuable hydrocarbon deposits, that may be produced using the seismic data acquired by the seismic sensors (Figure 1, ref. 130). See paragraph [0041].

## **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

1. Whether claims 5-6, 18, 30 and 35 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 6,430,105 ("Stephen) in view of US Patent No. 6,353,577 ("Orban").

2. Whether claim 25 was properly rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 6,430,105 ("Stephen) in view of Analog Devices (ADXL202E) ("ADXL202E").

## VII. ARGUMENT

### A. SUMMARY OF THE EXAMINER'S REJECTIONS

The Examiner takes the position that column 2, lines 1-58 and column 3, line 60 to column 4, line 63 of Stephen discloses determining at least one initial value of a DC signal of at least one orientation sensor coupled to at least one ocean bottom cable; and determining at least one current value of a DC signal of the at least one orientation sensor. The Examiner takes the position, without providing any support, that Stephen discloses calculating the orientation with the accelerometers in real time, and therefore there are continuous initial and current values of orientation being generated by the accelerometers. The Examiner further takes the position that column 2, lines 1-58; column 3, line 60 to column 4, line 63; and column 5, lines 20-45 of Stephen discloses comparing the initial value of the orientation sensor to the current value of the orientation sensor. The Examiner admits that Stephen does not specifically disclose determining whether the at least one ocean bottom cable has moved based on the comparison. However, the Examiner alleges that since the orientation signals generated by the accelerometers are processed in real time, a change in the orientation would be shown in real time. The Examiner then simply concludes that this change in orientation would indicate that the cable has moved.

The Examiner further admits that Stephen does not disclose the values of the orientation sensors as DC signal values and the type of signal generated by the accelerometers that allows for the orientation to be determined. The Examiner, however, attempts to supplement the missing limitation with Orban. More specifically, the Examiner takes the position column 3 of Orban teaches using accelerometers to determine orientation of seismic sensors based on the sensed acceleration due to gravity, which are in the form of DC signals. The Examiner simply concludes that it would be obvious that the accelerometers in Stephen would produce DC signals, since Orban teaches that the accelerations due to gravity sensed by the accelerometers are in the form of DC signals. Office Action 12/06/2006, pages 3-4.

**B. CLAIMS 5-6, 18, 30 and 35**

Appellants respectfully traverse this rejection. Stephen generally describes the use of ocean bottom cables in seismic surveying. Each ocean bottom cable has sensor units, each sensor unit having three orthogonally disposed accelerometers for measuring acceleration due to gravity and seismic vibration. See column 4, lines 15-21. Each of the three accelerometers is directed to a vertical axis (the “up” axis), along the axis of sensor unit (the “along” axis) and across the axis of the sensor unit in the horizontal plane (the “across” axis), respectively. Each accelerometer is sensitive only to accelerations applied along a particular axis on which it is disposed. (Column 2, lines 3-18). In one implementation, the seismic signal from the “up” axis accelerometer is transposed to give the seismic signal in the up axis, the seismic signal from the along axis accelerometer is transposed to give the seismic signal in the “along” axis and the seismic signal from the “across” axis accelerometer is transposed to give the seismic signal in the “across” axis. (Column 3, lines 3-10). More specifically, “[o]nce the orientation of a sensor 1 is so determined, the angle between the vertical 11, and each axis 8, 9, 10 of the sensor 1 is known. This can be used to form a transformation matrix to transpose the measured seismic signals to the reference vertical 11 and horizontal 12 13 axes. Thus the seismic data measured by each accelerometer 5, 6, 7 is transposed so that the sensor 1 gives three seismic signals in the required axes.” (Column 4, lines 41-48). Calculation of the orientation of the sensor and transposition of the seismic signals can be implemented in real time or at the time of processing the seismic data set. (Column 4, lines 54-56).

However, Stephen does not teach or disclose comparing an initial value of a DC signal of an orientation sensor to a current value of the DC signal of the orientation sensor. In contrast, Stephen proposes that once the orientation of a sensor is determined, the orientation may be used to transpose the seismic signals to the reference vertical and horizontal axes. See Stephen, column 4, lines 41-45.

The Examiner states that column 2, lines 1-58; column 3, line 60 to column 4, line 63; and column 5, lines 20-45 of Stephen discloses comparing the initial value of the orientation sensor to the current value of the orientation sensor. However, in the contrary, none of these passages teaches or suggests such limitation. In fact, the entire

document of Stephen makes no mention about comparing an initial value of a DC signal of an orientation sensor to a current value of the DC signal of the orientation sensor.

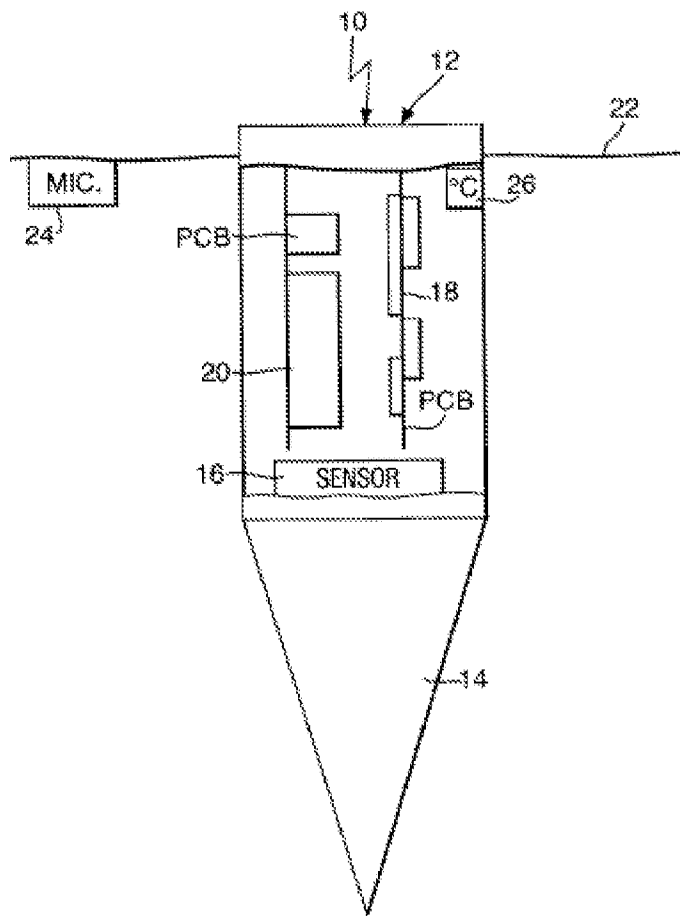
Stephen also does not teach or disclose determining whether the at least one ocean bottom cable has moved based on the comparison. As to this limitation, the Examiner concedes that Stephen does not specifically disclose determining whether the at least one ocean bottom cable has moved based on the comparison. However, the Examiner alleges, without any support, that since the orientation signals generated by the accelerometers are processed in real time, a change in the orientation would be shown in real time. The Examiner then simply concludes that this change in orientation would indicate that the cable has moved. Office Action 12/06/2006, page 3.

Appellants respectfully traverse this liberal interpretation of Stephen. Stephen simply states that calculation of the orientation of the sensor and transposition of the seismic signals can be implemented in real time or at the time of processing the seismic data set. (Column 4, lines 54-56). No where in Stephen does it state that these calculated orientations are (1) compared and then (2) used to determine whether the ocean bottom cable has moved based on the comparison. Since Stephen is not concerned about determining whether the ocean bottom cable has moved based on the comparison of the orientations of the sensors, Stephen is silent regarding this issue. Thus, Appellants respectfully submit that the Examiner's position is simply impermissible hindsight afforded by the claimed invention. See MPEP 2141.

Orban is generally directed to seismic sensor units for land applications. See column 1, lines 6-8. Figure 1 of Orban, which is reproduced below, illustrates a seismic sensor unit 10. The sensor unit 10 is equipped with a spike 14, which serves to plant the sensor unit 10 into the ground, thereby providing a sufficient acoustic and mechanical contact with the ground. See column 1, lines 20-22; column 3, lines 13-16. The seismic sensor unit 10 includes a sensor element 16, i.e., a feedback controlled accelerometer, which generates DC signals. Such DC signals are useful for verifying the verticality of the planted seismic sensor unit. See column 3, lines 25-27.



Fig.1.



However, like Stephen, Orban does not teach or disclose comparing an initial value of a DC signal of an orientation sensor to a current value of the DC signal of the orientation sensor, let alone determining whether the at least one ocean bottom cable has moved based on the comparison.

Thus, neither Stephen nor Orban, alone or in combination, teaches or discloses comparing the at least one initial value of the DC signal of the at least one orientation sensor to the at least one current value of the DC signal of the at least one orientation sensor; and determining whether the at least one ocean bottom cable has moved based on the comparison, as recited in claims 5, 18, 30 and 35. Furthermore, there is no “apparent reason to combine the known elements in the fashion” recited in claims 5, 18, 30 and 35. *KSR Int’l v. Teleflex, Inc.*, No 04-1350, slip op. at 14 (U.S. Apr. 30, 2007).

“To facilitate review, this analysis should be made explicit ... Rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *Id.*

Further, if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. MPEP 2143.01; *In re Ratti*, 270 F.2d 810 (CCPA 1959). Here, the Examiner’s proposed modification of placing the sensor units disclosed in Orban inside the ocean bottom cables disclosed in Stephen would significantly change the seismic surveying operation disclosed in Orban. As mentioned above, the sensor units in Orban require to be planted into ground, while the ocean bottom cables in Stephen are not planted into ground but are laid on the ground and are thereby subject to movements caused by currents and/or turbulence in the water. Placing the sensor units taught in Orban inside the ocean bottom cables taught in Stephen would prevent the sensor units taught in Orban from being planted into the ground, resulting in insufficient acoustic and mechanical contact with the ground. As such, the Examiner’s suggested combination of Stephen and Orban would require a substantial reconstruction and redesign of the elements shown in Orban as well as a change in the basis principle under which the Orban construction was designed to operate.

Further, “a patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the ‘subject matter as a whole’ which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103.” MPEP 2141.02 citing *In re Sponnoble*, 405 F.2d 578, 585, 160 USPQ 237, 243 (CCPA 1969). Here, to discover the problems caused by the movements of the ocean bottom cable after it is deployed and developing a method and/or system to determine whether the cable has moved is part of the claimed invention. The discovery of the problems caused by the movements of the ocean bottom cable is part of the claimed invention as well as the solution, i.e., comparing the orientation of the ocean bottom cable at different times. Neither Stephen nor Orban discusses the problems caused by the movement of

the ocean bottom cable. Such problems would not have been contemplated by Orban because the sensor units taught in Orban are designed to be planted into the ground with a spike. The sensor units are not expected to move after deployment.

For the above reasons, claims 5, 18, 30 and 35 are patentable over Stephen and Orban. Claim 6 is also patentable over Stephen and Orban since it depends from claim 5.

### C. CLAIM 25

As to claim 25, the Examiner admits that Stephen does not disclose a specific type of accelerometer. The Examiner, however, takes the position that column 5 of Stephen discloses that the accelerometers can be piezoelectric, piezoresistive or capacitive accelerometers. The Examiner further takes the position that pages 1 and 8-12 of ADXL202E teaches a capacitive, dual axis accelerometer formed on an integrated circuit chip that can be used to sense accelerations due to gravity. Therefore, the Examiner simply concludes that it would be obvious to modify Stephen to include the dual axis accelerometer formed on an integrated circuit chip taught in ADXL202E as the accelerometers used to sense accelerations due to gravity in order to measure full 360 degrees of orientation through gravity. Office Action 12/06/2006, page 9.

As mentioned above, Stephen does not teach or disclose determining whether the at least one ocean bottom cable has moved using the at least one initial inclination and the at least one current inclination. ADXL202E also does not teach or disclose determining whether the at least one ocean bottom cable has moved using the at least one initial inclination and the at least one current inclination. Neither Stephen nor ADXL202E, alone or in combination, teaches or discloses determining whether the at least one ocean bottom cable has moved using the at least one initial inclination and the at least one current inclination, as recited in claim 25. Furthermore, there is no “apparent reason to combine the known elements in the fashion” recited in claims 5, 18, 30 and 35. *KSR Int’l v. Teleflex, Inc.*, No 04-1350, slip op. at 14 (U.S. Apr. 30, 2007). “To facilitate review, this analysis should be made explicit ... Rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal

conclusion of obviousness.” *Id.* Accordingly, claim 25 is patentable over Stephen and ADXL202E.

#### **D. CONCLUSION**

For the above reasons, the Examiner’s rejections of claims 5-6, 18, 25, 30 and 35 under 35 U.S.C § 103(a) are improper. Appellants therefore request reversal of the final rejection of claims 5-6, 18, 25, 30 and 35. Allowance of such claims is also respectfully requested.

Respectfully submitted,

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## VIII. CLAIMS APPENDIX

5. A method, comprising:
- determining at least one initial value of a DC signal of at least one orientation sensor coupled to at least one ocean bottom cable;
  - determining at least one current value of a DC signal of the at least one orientation sensor;
  - comparing the at least one initial value of the DC signal of the at least one orientation sensor to the at least one current value of the DC signal of the at least one orientation sensor; and
  - determining whether the at least one ocean bottom cable has moved based on the comparison.
6. The method of claim 5, wherein the ocean bottom cable comprises a plurality of orientation sensors coupled thereto, and wherein comparing the at least one initial-value of the DC signal and the at least one current-value of the DC signal comprises comparing a plurality of initial-values of the DC signal and a plurality of current values of the DC signal of the plurality of orientation sensors.
18. A system for carrying out a seismic survey, comprising:
- at least one ocean bottom cable;
  - at least one seismic sensor coupled to the at least one ocean bottom cable;
  - at least one orientation sensor coupled to the at least one ocean bottom cable;
- and
- a signal processing unit capable of:
    - determining at least one initial value of a DC signal of the at least one orientation sensor;
    - determining at least one current value of a DC signal of the at least one orientation sensor;

comparing the at least one initial value of the DC signal of the at least one orientation sensor to the at least one current value of the DC signal of the at least one orientation sensor; and

determining whether the at least one ocean bottom cable has moved based on the comparison.

25. A system for carrying out a seismic survey, comprising:

at least one ocean bottom cable;

at least one seismic sensor coupled to the at least one ocean bottom cable;

at least one orientation sensor coupled to the at least one ocean bottom cable,

wherein the at least one orientation sensor is at least one of a single and a dual axis accelerometer formed on an integrated circuit chip; and

a signal processing unit capable of:

determining at least one initial inclination of the at least one orientation sensor;

determining at least one current inclination of the at least one orientation sensor; and

determining whether the at least one ocean bottom cable has moved using the at least one initial inclination and the at least one current inclination.

30. An article comprising one or more machine-readable storage media containing instructions that when executed enable a processor to:

determine at least one initial value of a DC signal of at least one orientation sensor coupled to at least one ocean bottom cable;

determine at least one current value of a DC signal of the at least one orientation sensor;

compare the at least one initial value of the DC signal of the at least one orientation sensor to the at least one current value of the DC signal of the at least one orientation sensor; and

determine whether the at least one ocean bottom cable has moved based on the comparison.

35. An apparatus, comprising:

means for determining at least one initial value of a DC signal of at least one orientation sensor coupled to at least one ocean bottom cable;

means for determining at least one current value of a DC signal of the at least one orientation sensor;

means for comparing the at least one initial value of the DC signal of the at least one orientation sensor to the at least one current value of the DC signal of the at least one orientation sensor; and

means for determining whether the at least one ocean bottom cable has moved based on the comparison.

## **IX. EVIDENCE APPENDIX**

None, other than that already of record.



**X. RELATED PROCEEDINGS APPENDIX**

None.